52. On some new Fossil Reptiles from the Permian and Triassic Beds of South Africa. By R. Broom, D.Sc., C.M.Z.S.

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(Plates XC.–XCIII.*)

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The following series of new reptiles forms an important addition to our knowledge of the Karroo faunas. The majority have been found by the Rev. J. H. Whaits, of Beaufort West. Of the others one was found by Mr. Alfred Brown, of Aliwal North, one by Mr. H. J. Hembury, and a few by myself.

Suborder Dinocephalia.

Taurops macrodon, gen. et sp. n. (Pl. XC. fig. 1.)

The snout of this large Dinocephalian was obtained at Bosmanshoek at the foot of the Komsberg. Though so little has been obtained we have enough to give the distinguishing characters of this new type. In size it almost equals *Tapinocephalus atherstonei*, but the snout though narrower is considerably deeper, and it differs in the great degree of development of the teeth, especially of the incisors. Where the snout is broken across, about the transverse plane of the back of the anterior nares, the width is 190 mm. and the height about 100 mm. The anterior nares are unusually small and situated about 90 mm. from the front of the snout. The distance between the two nostrils is about 45 mm. The condition of the bone renders it almost impossible to make out the sutures, the only one that is distinct being that between the two premaxillaries.

* For explanation of the Plates see p. 875.

The teeth are for the most part badly preserved, but as they are broken off at different levels and as a large number of replacing teeth are present, the structure can be made out without much difficulty. There are 14 teeth preserved, of which the first five are large and long. From the 6th backwards the teeth steadily decrease in size and the crowns become quite short. Possibly there are two or three teeth lost behind the 14th, but it seems improbable that there are many. The anterior teeth are of the usual Dinocephalian type. They are, except where the root is being absorbed by a replacing tooth, of great length, the whole root and crown being about 90 mm. The anterior cusp is long and narrow, and on section is semicircular. At its base it measures about 9 mm. across and gradually narrows towards the point. None of the anterior upper teeth shows the whole anterior cusp, but it probably measures about 20 mm. in length if not more. The posterior basal cusp is about 15 mm. in width and has a slightly concave surface. The posterior teeth have short cusps. The 12th tooth has a crown only 12 mm. in height.

The teeth in the lower jaw are apparently closely similar in type to those in the upper. Most of the functional teeth are badly weathered away, but the weathering shows that at the base of each is a well-developed replacing tooth similar in type to the functional one. It seems probable that the long anterior cusps of the front teeth interdigitated and that the grinding took place by the meeting of broad posterior cusps. The edges of the long anterior cusps would thus form an admirable cutting apparatus, and the internal cusps would take the part of molars. In the Dinocephalians almost the whole dental apparatus is placed in the front of the snout, and the absence of grinding molars such as are seen in the contemporaneous or slightly earlier American herbivores, e. g. *Diadectes*, is explained by the crushing or grinding function having been taken up by the peculiarly specialised incisors.

Suborder Dromasauria.

Galeops whaitsi, gen. et sp. n. (Pl. XCI. fig. 6.)

This new genus is founded on the anterior half of the skeleton of a Dromasaurian. The skull is crushed but fairly well preserved, and the shoulder-girdle and front limb are in good condition, while remains of about 18 vertebræ are seen. Unfortunately the matrix is very hard and little can be done in the way of development. The specimen was found by Mr. Whaits on the farm La-de-da, about 20 miles to the west of Beaufort West, and probably belongs to the upper part of the *Pareiasaurus*-Zone.

The skull is in many respects very remarkable. The orbit is exceedingly large and the temporal fossa deep and very narrow, and the squamosal has a long descending process which brings the quadrate below the back of the orbit. The face is very short, and there appear to be no teeth in either upper or lower jaw.

The bones of the skull are not in good condition for showing

sutures. The snout is missing in front of the nostril, but from the shape of the lower jaw its length can be fairly well assumed. The nostril is large and the distance between it and the orbit very short. It is probable that the septomaxillary meets the lachrymal. The suborbital and postorbital arches are slender. The frontal and parietal regions are both fairly wide and there is a large oval parietal foramen. The squamosal is somewhat like that of the Dinocephalia, but is slender and the descending process very long. There appears to be a distinct quadrato-jugal. The palate, so far as preserved, agrees with that of the Therocephalia. There is a pair of long slender prevomers, and the palatines and back of the pterygoids are not unlike those of *Scylacosaurus*, but whether in other respects the palate is Therocephalian or Dinocephalian the evidence does not show. Certainly the palate is not the least like that of the Anomodont. The lower jaw is short and toothless. It agrees fairly closely with that of the Anomodont, but there is a rudimentary coronoid process.

The shoulder-girdle has a large distinct precoracoid and coracoid loosely articulated to each other. The scapula is somewhat like that of the Dinocephalia and also a little like that of the Therocephalian *Ictidosuchus*, but unlike that of the Anomodont. The limb bones are long and slender.

Galeops is an entirely new type of Dromasaurian and represents a new family, the Galeopidæ, characterised by the absence of teeth and the presence of a small coronoid process. The other family, which may be called the Galechiridæ, includes *Galechirus* and *Galepus*, both with teeth and without a coronoid process.

Suborder Therocephalia.

Scymnognathus whaitsi, gen. et sp. n. (Pl. XC. figs. 4, 5.)

This interesting type was found by Mr. Whaits near Beaufort West. Within quite a small area remains of four or five animals were obtained. Unfortunately, most of the bones are extremely weathered, and so infiltrated with lime as to be practically limestone nodules so hard that any development is almost impossible. Two skulls are sufficiently well preserved to show the general characters of the genus, though it is impossible to be sure of most of the sutures.

The new type is a very near ally of *Gorgonops torvus* Owen, and it is only after considerable deliberation that I have decided to place it in a new genus. With perfect certainty it can be placed in the Family Gorgonopidæ. When Owen first described *Gorgonops* in 1876 he unfortunately came to the conclusion that the temporal fossa was roofed over as in Labyrinthodonts or *Pareiasaurus*, and this mistake was also made by Lydekker in 1890, and by Seeley in 1895. On examining the type and, at that time, only known specimen when in London three years ago, I discovered that the temporal fossa is not roofed over, though the parietal region is broad, and noted the observation in a paper

published in 1910*. Within the last few months Mr. Whaits has fortunately discovered a good skull of *Gorgonops* which shows that it has quite a large temporal opening, very similar to that in the present genus.

In general appearance *Scymnognathus* differs from the more typical Therocephalians mainly in having the intertemporal region about as wide as the interorbital. The snout is long, the orbits small, the temporal region fairly wide, and the squamosals more powerfully developed than in most Therocephalians.

The total length of the skull is, in the type, 305 mm. In a second but much crushed specimen the length is probably about 325 mm. From the front of the snout to the front of the orbit the measurement in the type is 165 mm., and the length of the orbit about 40 mm. The interorbital width in the type is 70 mm.: in another very imperfect specimen it measures 78 mm., and in a third about 76 mm. The narrowest part of the parietal region measures in one of the larger specimens 78 mm.

The parietal foramen is situated well back and is 6 mm. in diameter.

Though the limits of many of the bones cannot clearly be made out, much of the cranial structure can be seen. The bones of the snout seem to agree with those of the better known Therocephalians, though the septomaxillary is relatively larger. The jugal is unusually well developed and the postorbital is very large. The postfrontal also seems to be much larger than in any other type hitherto examined. The squamosal is more massive than in most Therocephalians, and the quadrate is relatively small and largely hidden by the squamosal. The occipital condyle is single.

The lower jaw is fairly similar to that previously described and figured in *Lycosuchus* and *Aloposaurus*. The front of the dentary is very deep and has a well-marked mental process. Posteriorly the dentary has a short coronoid process and for a considerable distance lies above the angular. The surangular is much smaller than in other known Therocephalians.

There are five upper incisors, one large canine and three or four molars. The incisors are long pointed teeth, oval in section, and apparently without serrations. The space occupied by the five incisors in three specimens is 37 mm., 39 mm., and 40 mm. The space between the last incisor and the canine in four specimens is 18 mm., 22 mm., 25 mm., and 26 mm. The length of the canine in seven specimens is 16 mm., 18 mm., 20 mm., 20 mm., 20 mm., 20 mm., and 21 mm. Behind the canine is a diastema varying from 7 mm. to 16 mm., followed by either three or four molars. The number of molars apparently depends on age. When three molars are present the distance occupied by them is 20 or 21 mm.: when four are present they occupy 25 mm. to 29 mm.

The dental formula is, i. $\frac{5}{4}$, c. $\frac{1}{1}$ m. $\frac{3 \text{ or } 4}{3 \text{ or } 4}$.

* "Observations on some specimens of South African Fossil Reptiles preserved in the British Museum." Tr. Roy. Soc. S. Afr. vol. ii. pt. 1, 1910, p. 20.

Scymnognathus may prove to be related to *Scymnosaurus*. The dental formulæ are practically the same in the two genera, but *Scymnosaurus* seems to be a higher type of Therocephalian, and the shape of the snout and lower jaw differs sufficiently markedly to justify one in keeping the genera distinct.

ÆLUROSAURUS STRIATIDENS, sp. n. (Pl. XCI. fig. 7.)

The imperfect snout which forms the type of this new species was discovered by me at Kuilspoort, near Beaufort West, at a horizon which is probably 500 feet above the town.

It is a smaller species than *Æ. felinus*, and in addition differs from this and the other known species in the relatively small size of the teeth, in the feeble development of the serrations, and in the incisors and canine having feeble vertical ridges on the enamel.

So far as preserved there is a pretty close agreement in the structure of the bones of the snout with those of previously described species. The septomaxillary is larger than usual. The mandible has a broad angular chin.

The incisors are small, rounded, pointed teeth, placed so near each other as to be almost touching. Those whose crowns are preserved (3rd, 4th, 5th) have the enamel folded into about half a dozen vertical corrugations. The 5th tooth has fine serrations on its posterior edge. The space occupied by the five incisors is 16 mm. The diastema between the 5th incisor and the canine is 7 mm.

The canine is long and slender. The base measures antero-posteriorly 7 mm. and the height of the crown as preserved is 14 mm. It originally probably measured about 20 mm. The molars are small with only faint indications of posterior serrations. Two are well preserved and there are remains of the other two. Probably 5 is the complete number, which would make the dental formula agree with the other species of *Ælurosaurus*. The four preserved molars measure 10 mm., and the front one is only 9 mm. behind the canine.

PRISTEROGNATHUS PLATYRHINUS, sp. n. (Pl. XCI. fig. 8.)

The specimen which I take as the type of this new species is an imperfect snout found by Mr. Whaits at Grootfontein, about 12 miles to the west of Beaufort West, and probably from the upper part of the *Pareiasaurus*-Zone. The specimen consists of the front half of the skull. It is broken into three pieces and the upper nasal region is missing. The matrix is extremely hard and difficult to clear off, but most of the characters can be satisfactorily made out.

In the large majority of Therocephalians the snout is deeper than broad. In this specimen the snout is broad and flat, and the lower jaw comparatively straight and with very little of the usual upcurving in the canine and incisor region. The widest part of the snout is immediately above the canine, where it measures 55 mm., and on the same plane the height of the snout is 40 mm.

There is very little crushing. Nearer the front of the nose the height is only about 25 mm. and the width 45 mm. The maxillary bone is rather deeply pitted. The palate is broad and flat behind and in front slopes upwards to the opening of the internal nares. The prevomers are narrow slender bones which in section are seen to have thin vertical plates. The palatines are apparently as in *Scylacosaurus*, but appear to approach each other more closely in the middle line. The pterygoids have each a very thin vertical plate which is closely placed against its neighbour.

There are apparently 6 incisors, though only evidence of the last five are preserved. The anterior ones are fairly round on section, but the last three are more flattened and have a posterior edge which is not improbably serrated. The teeth decrease in size as we pass backwards, the 6th being only about half the size of the 4th. The last four teeth occupy a space of 20·5 mm. and the whole six probably 30 mm. The diastema between the 6th incisor and the canine is 9 mm. The canine at its base measures 10 mm. by 7 mm. Behind the canine is a diastema of 7 mm. followed by 8 pointed molars. Each of the anterior molars has an antero-posterior diameter of nearly 3 mm., and the whole series occupies a space of 29 mm.

The dentition of the lower jaw is mainly concealed in front. Probably there are 3 incisors and 1 canine. The molars are well shown on the right side and are 8 in number, and occupy a space of 32 mm. There is no evidence of any serrations, and were they present the specimen would be expected to show some of them.

The dental formula is probably i. $\frac{6}{3}$, c. $\frac{1}{1}$, m. $\frac{8}{8}$.

There is some doubt whether this specimen belongs to the same genus as *Pristerognathus polyodon* Seeley. The type is only the front of a snout, and the number of molars is unknown, and only a figure of the underside is given by Seeley. However, the two specimens are probably from near the same horizon, and the arrangement of the teeth, so far as known, is sufficiently close to render it advisable to place this new species provisionally in Seeley's genus *Pristerognathus*.

ALOPECORHINUS PARVIDENS, gen. et sp. n. (Pl. XCI. fig. 9.)

This new genus is founded on an imperfect snout discovered by Mr. Whaits at Beaufort West. It consists of the greater part of the left maxillary and dentary and much of the right maxillary and dentary.

It resembles *Pristerognathus platyrhinus* in the broad short nose and approximates in dental formula, but differs in having a much more slender jaw and in the relatively smaller size of the teeth, especially the molars, and in having a much shorter precanine portion of the snout.

The anterior upper incisors are lost but there is evidence of the last three. The whole series probably measured 19 mm. The

diastema between the last incisor and the canine is only 2 mm. The canine measures at its base 6 mm. by 5 mm. The molars are at least 7 in number, and are small, pointed but apparently unserrated teeth. The seven occupy 17·5 mm. Between the canine and the first preserved molar is a diastema of 9 mm.

The lower incisors are preserved in section and are 4 in number, the 4th being inside the line of the others. The canine is far forward and small and rounded, the section measuring 3·5 mm. in diameter.

The dental formula is probably i. $\frac{6}{4}$, c. $\frac{1}{1}$, m. $\frac{7(?\,8)}{?}$.

Ictidognathus hemburyi, sp. n. (Pl. XCI. figs. 10, 11.)

This new species is founded on four imperfect snouts found by Mr. H. J. Hembury at Beaufort West. There are minor differences between the snouts probably due to crushing, to age, and possibly to sex, but I believe they all belong to one species. To avoid any possibility of confusion I shall take the skull (fig. 10) as the type. It is the best preserved specimen but does not show the molars satisfactorily.

As in *Alopecorhinus* the snout is broader than deep. This is probably also the case in *Ictidognathus parvidens*, but the only known specimen of this species is considerably crushed. From the front of the snout to the front of the orbit the measurement is 42 mm. The antero-posterior diameter of the orbit is 18 mm. The interorbital region is 19 mm. across. The measurement across the snout at the canine region is about 27 mm.

The premaxillary is a very small bone forming the anterior and lower margins of the nostril. It carries six small pointed, rounded, smooth incisors. I fail to detect serrations on any of them. The six incisors occupy a space of 10 mm.

The septomaxillary is unusually large and forms as large a part of the facial surfaces as does the premaxillary. There is the same foramen between it and the maxillary seen in typical Therocephalians, but it is relatively smaller than in other forms.

The nasal bone is well developed and is interesting from the fact that it is only very little broader behind than in front.

The maxillary is typically developed. As in so many Therocephalians, the centre part of the bone is markedly pitted as if for the accommodation of glands or sense organs. In the same region there are numerous foramina passing into the bone, and some of these foramina lead back into a canal in the bone. As there is no large foramen in the maxillary bone which might be regarded as the foramen for the maxillary branch of the Vth nerve, I think it probable that this nerve subdivides in the maxillary bone and comes to the surface by a number of small foramina, and that the pits were for sense organs which were supplied by this nerve. The tactile vibrissæ of mammals, or the remarkable sense organs of the beak of *Ornithorhynchus* may be the modified homologues of these supposed ancestral organs.

There are two canines—a very small anterior and a fairly large long slender posterior one. The small canine has a diameter of ·5 mm.: the large canine measures 3·5 mm. by 4 mm. The two are a little more than 2 mm. apart. The exact number of molars is a little doubtful but appears to be 8, and they occupy 16 mm. in one of the specimens. The molars appear to be all short, smooth, pointed teeth without serrations.

In the lower jaw there are four incisors, a large canine, and eight molars. The dental formula would thus be i. $\frac{6}{4}$, c. $\frac{2}{1}$, m. $\frac{8}{8}$. In *Ictidognathus parvidens* there are certainly nine upper molars and possibly ten, but as this species is certainly allied to *I. parvidens* it seems better to keep both in the same genus.

Suborder Anomodontia.

* Endothiodon whaitsi, sp. n. (Pl. XCIII. fig. 18.)

This new species is only known by the skull, a few vertebræ and ribs, and a couple of limb-bones. Fortunately the skull is in beautiful condition. The specimen was discovered by the Rev. J. H. Whaits at Beaufort West. It is a near ally to *Endothiodon uniseries* Owen, and has the molars in a single row, but it differs from *E. uniseries* in a considerable number of points besides in being nearly twice as large. In *Endothiodon uniseries* the greatest length of the skull is 360 mm.: in *Endothiodon whaitsi* the skull measures in length 570 mm. With the exception of *Oudenodon magnus* it is the largest known Anomodont. As I hope shortly to publish a full account of the genus *Endothiodon*, I shall here merely give a preliminary description of this interesting species.

The skull is narrow and deep. The greatest width across the squamosals is probably about 360 mm., while the interorbital region is only 140 mm. and the greatest width of the palate 150 mm. There is a slight degree of crushing, but not such as to make these measurements far wrong. The notch in the premaxilla for the point of the lower jaw is very deep and narrow. The nostrils are large, measuring 65 mm. by 45 mm. The nasals do not overhang them as in *E. uniseries*, the whole width of the nasals being only 85 mm. The orbit is situated 180 mm. behind the front of the snout and measures from 60 to 65 mm. in diameter.

The parietal crest forms a huge arch over the top of the head about 300 mm. in length. It is very narrow for its depth, and is mainly formed by the postorbitals and the squamosals, the parietals being relatively small. Near the union of the anterior and middle third the two postorbitals are pushed apart by an enormous development of the preparietal. This forms a prominent boss 90 mm. in length and 50 mm. in width, and rising 20 mm. above the edge of the postorbitals. In it is situated the

* See also Addendum, p. 875.

parietal foramen, which is only about 10 mm. in diameter. This is the more remarkable in that in *E. uniseries* the foramen measures nearly 20 mm. in diameter.

The zygomatic arch is very massive. The malar process of the jugal is less marked than in the smaller species. The squamosal extends forwards to below the postorbital arch. Anteriorly the zygomatic arch measures 65 mm. in depth and posteriorly 80 mm.

The lower jaw is very powerful and measures 400 mm. in greatest length.

* Endothiodon platyceps, sp. n. (Pl. XCIII. fig. 19.)

This new species was also discovered by Mr. Whaits, near Beaufort West. It is founded on a fairly complete but slightly crushed and probably barely mature skull. The lower jaw is complete, and the only important part missing from the skull is the whole of the nasal region and the anterior part of the frontal.

The greatest length of the skull is 275 mm., and the greatest width about 215 mm.

The frontal region is flat, and the parietal crest instead of rising up from this is continued straight back. There does not appear to be a distinct postfrontal bone. The preparietal is large and passes forwards for 35 mm. in front of the pineal foramen. The foramen is 14 mm. wide and 8 mm. in antero-posterior diameter. Behind it is a large boss formed by the preparietal. There is nothing particularly noteworthy about the squamosals, jugals, or occiput.

The dentition is better seen in the lower than in the upper jaw. It is made up of a series of 7 teeth in a fairly regular row. Behind this the same row has 9 more teeth, but median to these there appear others, so that the front half of the dentition is an irregular single row, the back half an irregular double row. Parts of the crowns of two teeth are preserved and there appear to be no serrations on them. If this prove to be the case, this species will require to be placed in a new genus, as *Endothiodon bathystoma* has the teeth markedly serrated in front and behind.

The lower jaw is pointed in front, but at the lower part of the symphysis it is very broad. The back part of the dentary is unusually slender. *Endothiodon platyceps* differs from *E. uniseries* and *E. whaitsi* in the double row of teeth behind and also in the flat broad head; while from *E. bathystoma* it differs even more markedly. The teeth are smaller than in the other species.

Prodicynodon beaufortensis, sp. n. (Pl. XCIII. fig. 21.)

This small species is founded on an imperfect skull obtained by me at Kuilspoort at about the same horizon at which *Taognathus megalodon* was found. The specimen consists of the crushed ant-orbital portion of a small skull with the front two-thirds of the

* See also Addendum, p. 875.

lower jaw in position. At first sight the skull might readily be taken for that of a small *Oudenodon*, but there are two marked differences. There are a number of small maxillary teeth, and the lower jaw ends in front in a pointed beak which fits into a deep depression in the premaxillary exactly as in *Endothiodon*. There is no tusk.

The nostril is 8 mm. in length by 7 mm. in depth. The orbit is 12 mm. behind the nostril. The inter-orbital width is probably 14 mm. Close to the outer edge of the maxillary bone are at least two small smooth pointed molars, and other molars are arranged in a row further in.

The lower jaw is almost typically Endothiodont.

The only form nearly related to the present one is that described by me eight years ago as *Prodicynodon pearstonensis*. The two agree in the arrangement and structure of the molars, but differ markedly in the proportions of the head. *P. pearstonensis* has a much broader snout and an enormous premaxillary. It also has the orbit much further back. As neither type is in good condition it is impossible to affirm with certainty that the two species belong to the same genus, but at present it will be convenient to keep them together.

When *Prodicynodon* was first described, and until recently, the presence or absence of a tusk was believed to be a generic distinction. *Dicynodon* and *Oudenodon* were believed to be distinct genera. For the last five years the evidence has been steadily accumulating in favour of the tusk being merely a sexual character, and now the evidence seems to be conclusive. Mr. Whaits has collected a large number of the common little Beaufort West Endothiodont *Diœlurodon whaitsi*, and tusked and tuskless specimens seem to be about equally common, while there are no other characters to separate the specimens. Mr. D. M. S. Watson has succeeded in obtaining two specimens of *Oudenodon bolorhinus* recently described by me from Kuilspoort, at the same locality as afforded the type, but one specimen is tusked and the other tuskless.

This conclusion will necessitate the giving up of the genera *Oudenodon* and *Opisthoctenodon* and placing the species of these old genera under *Dicynodon* and *Pristerodon*. Fortunately very little confusion will result, as I have for years assumed the possibility of the tusk being merely sexual.

Dicynodon laticeps, sp. n. (Pl. XCII. figs. 12, 13.)

This new species of *Dicynodon* is founded on a beautiful skull obtained by Mr. J. H. Whaits on the Nieuwveld. With the exception of the lower jaw being missing and the tips of the maxillaries with most of the tusks being broken off, the skull may be regarded as perfect. It belongs to the very unusual broad-headed variety of which only a few specimens are known. When viewed from above the resemblance is so close to *Dicynodon tigriceps* Owen as to suggest that it might be a young specimen,

but the palatal view shows that the tusk is differently placed and relatively very much larger.

The greatest length of the skull measured obliquely from the snout to the back of the squamosal is 270 mm., and the greatest width across the squamosal is also 270 mm.

The snout is very short and the nostrils completely roofed over by the projecting nasals. The breadth across the nasals is 83 mm. The premaxillary is broad and shallow. The maxilla is short and also shallow. The tusk is large and situated right beneath the orbit, and directed downwards. In diameter it measures 25 mm. by 28 mm. at its base. The frontal region is broad and flat, the narrowest part between the orbits being 63 mm. If there is a distinct postfrontal it is very small. The parietal foramen is large, measuring 15 mm. by 10 mm. The preparietal lies mainly in front of it. The parietals are unusually large, and the posterior branch of the postorbitals more slender than in most species. The postorbital forms the front half of the long slender post-orbital arch. The squamosal extends forwards below the post-orbital arch and has a large articulation with the maxilla. The pterygoids where they meet are broad and, except for the median ridge, flat. Considering the great width of the skull the quadrates are not far apart.

The general structure of the skull will be better understood from the illustrations given.

Dicynodon psittacops, sp. n. (Pl. XCII. fig. 17.)

In working at the troublesome genus *Dicynodon* we have constantly been in doubt as to whether the small *Dicynodon* specimens are distinct species or only young animals. Frequently they agree sufficiently in general shape and structure as to suggest the probability of their being young specimens of *Dicynodon leoniceps* or some other large species. But this is certainly not always the case. Many specimens of *Dicynodon jouberti* are known from the *Pareiasaurus* horizon and all small, while no large *Dicynodon* is known to occur in the same zone. At Beaufort West a considerable number of specimens of a small *Dicynodon* also occurs, but there is no evidence of any large *Dicynodon* having lived at the period. The large Anomodonts are the Endothiodons. There is thus satisfactory evidence that the common *Dicynodon* of the Beaufort West commonage is an adult animal, and apparently a new species. The best specimens are a good skull with much of the skeleton and a fairly good skull with nearly the complete skeleton. I take the latter as the type. Both specimens were obtained by Mr. J. H. Whaits.

The greatest length of the type skull is 102 mm., and of the second specimen 112 mm. The width of the type across the squamosals is about 66 mm. Across the maxilla the maximum width is 42 mm. The interorbital width is 20 mm., and the intertemporal 18 mm.

The following are the most noteworthy characteristics of the

species. The nasals are so narrow that the nostrils look almost directly upwards. The upper part of the nasals is thickened, and the prefrontal region of the orbital margin is also elevated. The frontal region is broad and flat. The parietal foramen is situated in an elevated preparietal. The postorbitals approach each other behind the foramen and nearly touch, forming a parietal ridge. The tusk is small and directed forwards and downwards. The lower jaw has the front portion unusually broad and deep. The foramen behind the dentary is very small.

The whole skeleton from the snout to the end of the tail probably measures 500 mm.; the humerus measures 50 mm. and the femur 58 mm.

Dicynodon lutriceps, sp. n. (Pl. XCII. figs. 14–16.)

The type of this new species is an imperfect skull found by me at Kuilspoort, Beaufort West district. The skull has lost the tip of the beak, the postorbital and zygomatic arches, and there is about 20 mm. missing from the postpterygoid and from the parietal region so that the contact between the occipital and anterior portions of the skull is lost, but otherwise the skull is complete.

The most noteworthy characters of the type are the relative shortness of the beak, the broad concave frontal region, and the broad flattened intertemporal region, the upper surface of which is almost entirely formed by the postorbitals. In a maxillary from the same locality, and believed to be of the same species, the tusk is feeble and directed downwards and slightly forwards.

The greatest length of the skull from the snout to the back of the squamosal is about 195 mm., and the greatest width across the squamosals is 145 mm. From the front of the beak to the orbit is probably about 48 mm., and the antero-posterior diameter of the orbit is about 43 mm. The interorbital width is 35 mm., and the intertemporal region 29 mm.

The type specimen is tuskless. The caniniform process is directed downwards and forwards and has a marked low outer ridge which passes upwards towards the jugal arch. Below the nostril is an anterior ridge parallel to the other and forming a well-marked valley between the two. The nostril is fairly large and the nasal is considerably thickened above it, forming an overhanging supranasal ridge.

The prefrontals are small, but the frontals are well developed. Posteriorly they enclose between them the small preparietal and meet the anterior ends of the parietals. The postfrontals are long and narrow. The preparietal is small and seems to lie entirely in front of the pineal foramen. The postorbitals are very large where they overlap the parietals, but the postorbital arch is unusually feeble.

The parietals are large and powerful, but are almost completely

hidden by the postorbitals. There has been a little doubt as to whether the pair of bones usually supposed (Seeley, Broom, etc.) to be parietals are really the parietals, or whether the median bone in which lies the pineal foramen, and usually called the preparietal (Seeley, Broom) or interparietal (Newton), may perhaps be the true parietal. This latter view has recently received the support of Jaekel. The median bone, called for convenience preparietal, is met with in most Anomodonts. In some (*Endothiodon*) it is very large; in others (*Cistecephalus*) it is quite absent. The size of the paired bones depends to a considerable extent on the development of the preparietal. In *Cistecephalus* there can hardly be any doubt that the large pair of bones behind the frontals are the parietals. They have the same relations to the squamosals, interparietal, frontals, and postorbitals as the parietals have in most reptiles, and there can be, I think, no reasonable doubt but that these bones are homologous with the parietals of the mammals. When the preparietal appears and the intertemporal region becomes narrowed the parietals are much reduced in front, but posteriorly the relations to the squamosals, interparietal, and postorbitals remain constant. In *Endothiodon* the preparietal is so large that the parietal seems to be completely separated from it by the frontal. In *Dicynodon*, as exemplified by this skull, the parietals still meet the frontals. What the preparietal is, is not clear. It certainly is not the interparietal. I am inclined to look on it as a neomorph developed in connection with the pineal eye. There is no trace of it known in Dinocephalians, Dromasaurians, Pelycosaurs, Therocephalians, or Cynodonts, though in some of these the pineal eye was probably as large as even in *Endothiodon*.

There is little of special note in the palate or occiput.

The horizon from which the specimen was obtained is probably about 300 feet above that of Beaufort West.

EMYDOPS MINOR, gen. et sp. n. (Pl. XCIII. fig. 20.)

When Owen, in 1876, described the specimens of *Cistecephalus* in the British Museum, he named one species *Kistecephalus arctatus* and referred two specimens to it. The type differs very considerably from *Cistecephalus microrhinus*, the type species of the genus, and Lydekker in his Catalogue places *C. arctatus* doubtfully under *Cistecephalus*. On more than one occasion I have also expressed the opinion that *C. arctatus* does not belong to *Cistecephalus*.

Recently, I discovered at Kuilspoort a small imperfect skull which apparently belongs to the same genus as Owen's *C. arctatus*, though a distinct species. Pretty certainly the genus is not *Cistecephalus*, and the question arises, is it *Oudenodon*, or rather *Dicynodon*? The only specimens known are tuskless, and there are apparently no molar teeth. In the imperfect state of the specimens it is impossible to clearly differentiate the genus from

Dicynodon at present, but there seems little doubt they represent, if not a distinct genus, at least a subgenus. The more noteworthy characters are the wide parietal region with large parietals, slender postorbital arch, and feeble beak.

The length of the skull is probably about 45 mm., and the greatest breadth about 30 mm. The orbit measures 12 mm. in diameter. The intertemporal region is 14 mm. across.

The beak is in very imperfect condition, and little can be made out with certainty as to its structure. It may be stated with confidence that it was short.

The frontals are large, and form an interorbital region 10 mm. wide. From near the supraorbital margin to the anterior end of the parietal there runs backwards and slightly inwards a shallow groove. There is a moderate sized triangular postfrontal and a large median preparietal. This latter seems to lie entirely in front of the pineal foramen. The parietals are large and form the greater part of the broad intertemporal region. The postorbital is long and slender. It forms a feeble postorbital arch and the inner margin of the temporal fossa. The squamosal is of the typical Anomodont type. Its zygomatic position extends forwards to below the orbit. The articular region is badly preserved.

The lower jaw is very like that of *Oudenodon*, but the beak portion is small, and probably little more than the symphyseal region was covered with horn.

Suborder Cynodontia.

Ictidopsis elegans, gen. et sp. n. (Pl. XCIII. fig. 22.)

This new genus and species is founded on a nearly perfect little skull obtained at Harrismith, Orange River Colony. It is a very near ally of *Nythosaurus larvatus* Owen, but is much smaller, and differs in the number of molars and in other cranial characters.

In general shape the skull agrees fairly well with *Nythosaurus*. The orbit is near the middle of the skull and relatively larger than in the better known genus, while the jugal arch is more slender. In *Ictidopsis* the snout is shorter, and the molars are 6 in number instead of 7.

The greatest length of the skull is probably 63 mm. and the width is 42 mm. The interorbital width is 12·5 mm.

The premaxillary bone is badly preserved, but it is manifest that there are four incisors. The first three incisors are moderately round, but the last is more flattened. There do not appear to be any posterior serrations.

The maxillary is relatively shorter than in *Nythosaurus*, and deeper. Above the canine, and in front of the lachrymal are little elevations of the bone. On the canine elevated area are three small foramina and near the root of the 3rd molar two other

foramina, while two more are near the anterior end of the bone. As there is no single large supra-maxillary foramen, it is probable that all these small foramina are for branches of the maxillary nerve. The canine is long and slender. It is ridged somewhat after the manner of the canine of the cat. Behind it are 6 molars. The 1st is small, pointed, and without any cusps. The 2nd, 3rd, 4th, and 5th all closely resemble one another. There is a large pointed median cusp and a small anterior and posterior cusp. While essentially similar in type to the molars of *Nythosaurus* they differ in that the anterior and posterior cusps are relatively smaller. The 6th molar is a small tooth, and unfortunately the crown has been lost from both sides of the skull.

The incisors measure about 6·5 mm. Behind the last incisor is a diastema of 4 mm. The canine measures antero-posteriorly about 2·5 and its height is 7 mm. At a distance of 1·5 mm. behind the canine is the 1st molar, and the whole series of six occupies the space of 13 mm.

Only a small fragment of the septo-maxillary is preserved, but it manifestly forms part of the face, and was probably as in *Nythosaurus*.

The nasal is moderately wide in front, but narrows on passing backwards, and then near its middle it becomes about twice as wide as in front. Round the bone near where it meets the maxilla is a series of three or four foramina.

The lachrymal forms the front of the orbit and, as in *Nythosaurus*, it is larger than the prefrontal.

As in *Nythosaurus* and most Cynodonts the prefrontal meets the postorbital, shutting out the frontal from the orbital margin. The postorbital forms about half of the postorbital arch and overlaps a small part of the parietal.

The parietal is large, and there is an obvious pineal foramen.

The squamosal is like that of *Nythosaurus*, except that in *Ictidopsis* there is a much more prominent auditory groove.

The fractured edge of the occipital crest shows the interparietal distinct from the parietals, and the lateral bone, which I believe to be the opisthotic, distinct from the parietal, the interparietal, and from the squamosal.

The occiput and palate have not been cleared.

The dentaries are in position, but the posterior bones of the jaw have been detached and displaced, probably by insects before the skull was fossilized.

The type of *Ictidopsis elegans* was found at Harrismith in association with *Lystrosaurus*. Unfortunately the geology of Harrismith is unknown. Some of the first specimens of South-African Dinosaurs were got there by Mr. J. M. Orpen in 1853, and there can be no doubt that these are from the Red Beds of the Stormberg Series. It is not a little startling to find that the same commonage yields fossils which in Cape Colony belong to a horizon about 3000–4000 feet lower than the Red Beds. Probably the Molteno

Beds and the Burghersdorp Beds are greatly thinned out, or possibly there is an unconformity.

Some years ago I divided the Upper Beaufort, or Triassic Beds, into three zones: (1) the *Lystrosaurus*-Zone, (2) the *Procolophon*-Zone, and (3) the *Cynognathus*-Zone. While these zones in the main hold good, the limits of them are still unknown. In the extensive *Lystrosaurus* beds of Colesburg, Middelburg, and Cradock no Procolophons or Cynodonts are known; but Mr. D. M. S. Watson has recently found *Lystrosaurus* associated with Cynodonts to the west of Burghersdorp, and a similar association we now know occurs at Harrismith. Again, while no *Lystrosaurus* or Cynodont remains are certainly known from the *Procolophon* beds, the *Procolophon*-like genus *Thelognathus* occurs at Aliwal North with Cynodonts, and possibly *Procolophon* itself. It seems not improbable that later work will further subdivide the Triassic Beds, each zone counting from the point where a new type begins, but before we can make any further advance with confidence we require to have a much fuller knowledge of the distribution of the fossils of the Upper and Middle Trias.

In the meantime I think we are safe in stating that *Nythosaurus*, *Ictidopsis*, and probably *Galesaurus* come from an older zone than the *Cynognathus* beds. None of the known specimens have been found near Burghersdorp, nor have any traces of *Lystrosaurus* ever been found, from which we may conclude that *Lystrosaurus* and probably these small Cynodonts became extinct before *Cynognathus* appeared.

Nythosaurus browni, sp. n. (Pl. XCIII. fig. 23.)

This new species is founded on an imperfect lower jaw obtained by Mr. Alfred Brown at Aliwal North. A large part of both dentaries is present, but most of the symphyseal portion is missing with the canines and incisors. Five molars are well preserved on the left side and three on the right.

While in a number of respects the specimen differs from *Nythosaurus larvatus* Owen, it seems probable from the position of the symphysis that there were seven molars, and as in general structure the molars agree with those of *Nythosaurus larvatus*, we may consider it as probable that the species belongs to this genus.

The dentary differs from that of *Nythosaurus larvatus* in having a more slender horizontal ramus, in having a more marked angle, and in the ascending ramus passing more upwards.

The molars preserved are probably the 3rd to the 7th. All have three cusps. What is apparently the 3rd molar has the median cusp short, and the others only feebly developed. In the 4th and the other later molars the middle cusp is about twice as long as the anterior and posterior cusps. In the second last molar there is an additional small anterior cusp which gives it four cusps, but there appear to be only three cusps in the last molar. The five molars occupy 13·5 mm.

Though the crowns of the molars resemble considerably those of the Triconodont mammals there is the marked difference that in *Nythosaurus* there is no trace of a cingulum, and there is apparently only a simple root to each tooth.

Addendum (29th July, 1912).—Since the above paper was read evidence has been obtained which shows that the genus *Endothiodon* must be subdivided. Seeley twenty years ago placed *Endothiodon uniseries* in a distinct genus, *Esoterodon*, and until quite recently I have followed him in this. A fragmentary maxilla recently found by Mr. Whaits shows that Seeley was correct. In *Endothiodon bathystoma* the teeth have long pointed crowns with coarse serrations both in front and behind. In *Endothiodon uniseries* the teeth have flattened crowns serrated only behind, and in *Endothiodon platyceps* there are no serrations on either side. This latter point has been confirmed in a second specimen. Until the crowns of the teeth of *Endothiodon whaitsi* are known we may provisionally place it with *Endothiodon uniseries*. The group would thus be formed of

Endothiodon bathystoma Owen.
Esoterodon uniseries Owen.
Esoterodon whaitsi Broom.
Emydochampsa platyceps Broom, gen. nov.

EXPLANATION OF THE PLATES.

Plate XC.

Fig. 1. Side view of snout of *Taurops macrodon* Broom. Nearly $\frac{1}{2}$ nat. size.
Fig. 2. Side view of tooth of probably *Eccasaurus priscus* Broom. Nat. size. This tooth, though not associated with the type of *Eccasaurus priscus*, is from the same horizon, and as it is the tooth of a Dinocephalian of the size of *Eccasaurus* it very probably belongs to this genus and species.
Fig. 3. Upper view of tooth of probably *Eccasaurus priscus* Broom. Nat. size.
Fig. 4. Side view of skull of *Scymnognathus whaitsi* Broom. A little over $\frac{1}{3}$ nat. size. The skull is much flattened and distorted by crushing.
Fig. 5. Lower jaw of *Scymnognathus whaitsi* Broom. $\frac{1}{3}$ nat. size. Though this jaw is rather smaller than that of the type specimen it almost certainly belongs to this species. It may have belonged to a young animal or to a female. The specimen is considerably crushed.

Plate XCI.

Fig. 6. Side view of the skull of *Galeops whaitsi* Broom. Nat. size. The specimen is slightly crushed and considerably weathered. The orbital margins and the preorbital portion of the skull and the lower jaw are the outer surface of the bones viewed from within. The back portion of the skull shows the quadrate and parts of the squamosal and opisthotic. A sclerotic plate is seen in the orbit.
Fig. 7. Side view of snout of *Ælurosaurus striatidens* Broom. Nat. size. The specimen is considerably crushed.
Fig. 8. Side view of snout of *Pristerognathus platyrhinus* Broom. $\frac{7}{10}$ nat. size.
Fig. 9. Under view of snout and lower jaw of *Alopecorhinus parvidens* Broom. $\frac{11}{16}$ nat. size.
Fig. 10. Upper view of imperfect skull of *Ictidognathus hemburyi* Broom. Nat. size.
Fig. 11. Under view of snout of *Ictidognathus hemburyi* Broom. Nat. size.

PLATE XCII.

Fig. 12. Upper view of skull of *Dicynodon laticeps* Broom. $\frac{5}{16}$ nat. size.
Fig. 13. Under view of snout of *Dicynodon laticeps* Broom. $\frac{5}{18}$ nat. size.
Fig. 14. Side view of skull of *Dicynodon lutriceps* Broom. $\frac{5}{12}$ nat. size. The contact between the front part of the skull and the occiput is missing, but the relation of the parts must be almost as restored.
Fig. 15. Upper view of skull of *Dicynodon lutriceps* Broom. About $\frac{5}{16}$ nat. size.
Fig. 16. Palatal view of skull of *Dicynodon lutriceps* Broom. About $\frac{5}{16}$ nat. size.
Fig. 17. Upper view of skull of *Dicynodon psittacops* Broom. About $\frac{1}{2}$ nat. size.

PLATE XCIII.

Fig. 18. Side view of skull of *Endothiodon whaitsi* Broom. About $\frac{2}{3}$ nat. size.
Fig. 19. Upper view of lower jaw of *Endothiodon platyceps* Broom. About $\frac{5}{18}$ nat. size.
Fig. 20. Upper view of skull of *Emydops minor* Broom. $\frac{5}{9}$ nat. size.
Fig. 21. Side view of skull of *Prodicynodon beaufortensis* Broom. About $\frac{7}{10}$ nat. size.
Fig. 22. Upper view of skull of *Ictidopsis elegans* Broom. $\frac{5}{6}$ nat. size.
Fig. 23. Side view of left dentary of *Nythosaurus browni* Broom. $\frac{5}{6}$ nat. size.

53. On the Hydrocoralline Genus, *Errina*. By Professor S. J. HICKSON, F.R.S., F.Z.S., The University of Manchester.

[Received April 29, 1912: Read June 4, 1912.]

(Plates XCIV.–XCVI.)

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Four years ago Professor Benham sent to me some specimens of Stylasterina from New Zealand, with a request that I would name them for him. At the same time he forwarded some notes and drawings which have proved to be of considerable assistance to me in working out their details. I am also indebted to Professor Dendy for the loan of another specimen also from New Zealand; to the late Mr. Morgan, of Worthing, for the loan of a specimen from an unknown locality; and to Mr. Gilchrist for a specimen from the Cape of Good Hope.

All these specimens clearly belong to one of three genera, *Errina*, *Labiopora* or *Spinipora*, as they exhibit the characters that these genera exhibit in common and by which they can be separated from other Stylasterina. These characters are: (1) a